REMARKS

This timely filed Reply is responsive to the Final Office Action mailed November 3, 2005 and is accompanied by a Request for Continued Examination (RCE) along with an authorization to charge the required statutory fee. Claims 1-25 were pending at the time of the Office Action. All 25 claims were rejected in the Office Action based on previously cited Wooden et al. (US 4,297,394) which was used as a primary reference.

Several drawings have been rejected due to shading issues. Specifically, figures 2(a), 2(b), 3, 4(a) – 4(d), and 8 were rejected based on dark shading. Applicants have provided replacement drawings herewith for these rejected figures.

Applicants and the undersigned wish to thank the Examiner for the telephone conference held on November 30, 2005. During the teleconference the Examiner reiterated the basis of the rejections which generally relied the Examiner's "broadest interpretation" of Applicants' claimed terms and phrases. Although Applicants acknowledge that a broad claim interpretation used by an examiner is sometimes advantageous as it can reduce the possibility that the claim, once issued, will be interpreted more broadly than is justified, Applicants respectfully remind the Examiner of MPEP 2111 and related case law. MPEP 2111 is entitled "Claim Interpretation; Broadest Reasonable Interpretation" and recites "During patent examination, the pending claims must be "given the broadest *reasonable* interpretation *consistent with the specification.*" Accordingly, the "broadest interpretation" must a *reasonable* interpretation (and thus not be strained), and must also take into account Applicants' specification to ensure the interpretation is *consistent with the specification.*

In this Reply, claims 1-4, 7, 9, 10, 16, 17, 19, 20, 21, and 25 have been amended, and new claims 28 and 29 have been added. Support for the new claim limitations recited in amended claim 1 can be found as follows:

"a plurality of discrete features electrically isolated from one another" – see paragraphs 49, 50 and 53, as well as Figs. 2(a) and 2(b).

"electrochemically oxidizable and reducible"- see paragraphs 7, 13, 15, 17, 18, 25, 32-34 and 36-38.

"electrically conductive polymer" "having at least a partially conjugated polymer backbone" see paragraph 37 as well as the specific conjugated polymer species disclosed in the application (e.g. polypyrrole (PPy), poly(p-phenylene) (PPP).

"room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm" can be in paragraphs 29 and 30.

Support for the claim 4 limitation "(R) of at least 2, R being defined as the ratio of actual surface area (Ract) to the geometric surface area (Rgeo); R = Ract/Rgeo)" can be found in paragraph 64.

Support for the "electrochemically active counter electrode spaced apart from said coating" and "aqueous solution including an electrolyte in contact with said coating and said counter electrode" recited in amended claim 16 can be found in paragraph 58. Accordingly, no new matter has been added.

Before reviewing the cited art, Applicants will first review the claimed invention recited in claim 1 as amended. Amended claim 1 recites a dynamic polymer-based coating, comprising:

at least one patterned polymeric layer including a plurality of discrete features electrically isolated from one another for attachment to a surface, said polymeric layer including

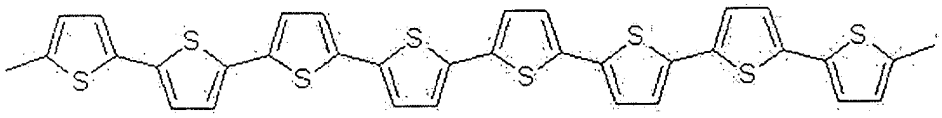
at least one electrochemically oxidizable and reducible and electrically conductive polymer (EORECP), said EORECP having at least a partially conjugated polymer backbone and providing a room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm, and

an electrode layer in electrical contact with said EORECP.

The patterned polymeric layer now recites "a plurality of discrete features electrically isolated from one another" thus defining a pattern now having recited specifics which define the pattern. The electrochemically oxidizable and reducible aspect (electrochemical activity) has been now added to claim 1 to make clear the important material characteristic of the claimed polymer is not the same (nor does it bear any similarity) to a change in physical dimension of the polymer, such as the reduction in size asserted by the Examiner "to be given the meaning of terms [referring to reduction] in their broadest interpretation". Specifically, on page 9 of the Office Action the Examiner equated a "reduction in curvature" with the reduction recited by Applicants in former claim 2 which recited "wherein said polymer layer substantially expands or contracts in at least one direction upon at least one of oxidation and reduction.

The now claimed "at least a partially conjugated polymer backbone" is a newly recited limitation. The meaning of a conjugated polymer is clear to one having ordinary skill in the art, and is reviewed below for convenient reference.

Conjugated polymers include alternating single and double bonds along the polymer chain (sp_2-hybridised carbons). The π-electrons form a common π-electron system along the whole polymer chain. This π-electron system gives the polymers (at least) semiconducting properties. One of several different types of conjugated polymers is polythiophenes (disclosed in Applicants' application, e.g. paragraph 39), see below.



Structure of polythiophene which is one type of conjugated polymer.

Finally, the "room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm" provided by the EORECP is now recited to make clear that the electrical conductivity recited in claim 1 is provided by the EORECP, *which is the same polymer that provides conjugation and electrochemical activity (reducible and oxidizable)*. Moreover, the recited "electrical conductivity of between 0.1 S/cm and 1,000 S/cm" is for a single polymer (the EORECP), not some polymer composite.

Turning now to the cited art, claims 1-3, 7, 16-20 and 24 were rejected under 35 U.S.C. § 102(b) as being anticipated by Wooden et al. (US 4,297,394). Regarding Wooden et al. '394, the Examiner (beginning on paragraph 5) asserts that:

Wooden et al 394 discloses a dynamic polymer-based coating, comprising at least one patterned polymeric layer 416, 416' for attachment to a surface 410, said polymeric layer including at least one electrically conducting polymer as disclosed in column 4, lines 40-44, wherein a contact angle of said polymeric layer substantially increases or decreases upon at least one of oxidation and reduction by vibration of the film of polymers 416, 416'.

The vibration of the polymeric layer leads to the layer substantially expanding or contracting in at least one direction upon at least one of said oxidation and reduction. Wooden et al 394 also discloses a non-toxic biofouling preventative system comprising a polymer-based coating 416, 416', 418 disposed on a subsurface of a boat or ship 310, said coating comprising a polymeric layer 416, said polymeric layer 416 including at least one electrically conducting polymer as disclosed in column 4, lines 40-44, and

a power supply 320 for supplying a dynamic electrical signal to said polymeric layer, wherein a contact angle of said polymeric layer substantially increases or decreases upon at least one of oxidation and reduction responsive to said dynamic signal by vibration of the polymeric layers.

The coating of Wooden et al comprises a pattern of a plurality of micro scale or nanoscale features. Such features can any of the microscopic particles making up the layers.

The coating of Wooden et al 394 is a polymer composite, said composite including at least one non-electrically conducting polymer 416 mixed with said electrically conducting polymer, which is the cement discussed in column 4, lines 40-44.

In Wooden et al 394 the polymeric layer is a patterned polymer layer, the pattern being provided by layer 416, layer 418 and layer 416'.

Applicants respectfully disagree with much of what is asserted above regarding Wooden. Wooden is entitled "Piezoelectric polymer antifouling coating and method of use and application". Wooden discloses an antifouling coating with method of use and method of

application on marine structures in the form of a film containing *piezoelectric polymer material.* When electrically activated with an alternating voltage the piezoelectric polymer material vibrates at a selected frequency to present a surface interfacing with water which is described as being inhospitable for attachment of vegetable and animal life including free-swimming organisms thereby discouraging their attachment and their subsequent growth thereon. In that the piezoelectric surface vibrates in response to the applied AC bias, Wooden's piezoelectric coating does function as a dynamic coating.

Wooden does not disclose or suggest, and in fact teaches away, from electrically conducting polymers. Piezolectric materials are by definition dielectrics, otherwise they cannot provide the required transduction between vibrational and electrical energy. The piezoelectric effect produces a voltage between surfaces of a solid dielectric (a dielectric is the opposite of an electrically conducting substance) when a mechanical stress is applied to it, or when a voltage is applied across certain surfaces of a solid that exhibits the piezoelectric effect, the solid undergoes a mechanical distortion.

Wooden's piezoelectric polymers are PVDF, PVF, and cellulose acetate buterate (col. 3, lines 15-18). These are all known to be dielectric materials which have an electrical conductivity at room temperature of substantially less than 10^{-6} S/cm, with PVDF as noted above being about 10^{-14} to 10^{-15} S/cm. Col. 3, lines 11-18 discloses this aspect of Wooden:

> Coating 312 is comprised of a film of plural layers of piezoelectric polymer such as poly(vinylidene fluoride) in the form of a film adhered by a conductive cement (not illustrated) to the surface of structure 310 in electrical contact therewith. Other piezoelectric polymeric materials such as polyvinyl fluoride or cellulose acetate butrate, for example, may be used in the coating.

The Examiner generally relies on Fig. 2 of Wooden. According to the Examiner in paragraph 5 of the Office Action:

> Wooden et al 394 discloses a dynamic polymer-based coating, comprising at least one patterned polymeric layer 416, 416' for attachment to a surface 410, said polymeric layer including at least one electrically conducting polymer as disclosed in column 4, lines 40-44, wherein a

Applicants respectfully disagree with the assertion above that the "patterned polymeric layer 416, 416' " "includes at least one electrically conducting polymer".

Applicants first refer to col. 3, lines 60-65 that refer to Fig. 2, which discloses:

The FIG. 2 embodiment shows a coating 412 comprises of two layers 416 and 416' of piezoelectric polymer on either side of a common conductor sheet or electrode 418 which may be formed by an electrically conductive cement.

Accordingly, the electrically conductive layer 418 is clearly a separate layer from the piezoelectric layers 416 and 416' (despite the assertion by the Examiner to be the same layer as the "patterned polymeric layers").

Moreover, the only electrically conductive layer disclosed by Wooden is a silver filled epoxy tape (col. 4, lines 40-44) which is used exclusively to cement the piezolectric (dielectric) to the surface to be protected ((col. 4, lines 40-47). The electrical conductivity of the tape is provided by the metallic silver particles since epoxy polymers are well known to be dielectric materials.

The Examiner asserts that the silver-epoxy composite is "an electrically conductive polymer" based on the reasoning copied below (paragraph 13 of the Office Action):

the at least one electrically conducting polymer is the "electrically conducting cement..., such as a silver filled epoxy which polymerized at around room temperature". Is this not an electrically conducting polymer? The layer of 416, 418 and 416' includes at least one electrically conducting polymer 418. It does not matter that the silver provides the conductivity. If the silver is part of the polymer, than the polymer is conducting.

Applicants respectfully point out that Wooden's silver filled dielectric polymer (epoxy) is not an electrically conductive polymer. Well known to those having ordinary skill in the art in polymer science, to become part of a polymer a material must either be integrated into the polymer backbone or become bound to the backbone (grafts). The silver in the silver filled epoxy is a filler as correctly noted by the Examiner above. As such, the filler does not become "part of the polymer" as it is neither part of the polymer backbone or grafted to the backbone, nor does the presence of silver render the dielectric polymer to become "conducting" as asserted by the Examiner.

In contrast to Wooden, amended claim 1 recites:

"patterned polymeric layer including a plurality of discrete features electrically isolated from one another". As amended, the pattern recited in amended claim 1 is not disclosed or suggested by Wooden.

The (EORECP) recited in amended claim 1 is a single polymer which provides:

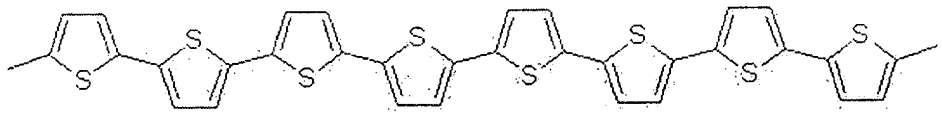
i) at least a partially conjugated polymer backbone;

ii) is electrically conductive, providing a room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm, and

iii) is electrochemically oxidizable and reducible (electrochemically active)

Regarding i) Applicants' claimed EORECP having "at least a partially conjugated polymer backbone"

As noted above, conjugated polymers consist of alternating single and double bonds along the polymer chain (sp_2-hybridised carbons), such as the polythiophenes disclosed in Applicants' paragraph 39, shown below.



Wooden does not disclose or suggest any conjugated polymers. Epoxies are non-conjugated ring-shaped organic compound consisting of an oxygen atom bonded to two other atoms, usually of carbon, that are already bonded to each other. The polyvinyl fluoride and cellulose acetate butrate (piezoelectrics) disclosed by Wooden are also not conjugated polymers. Accordingly, Wooden does not disclose or suggest Applicants claimed EORECP having "at least a partially conjugated polymer backbone"

ii) Regarding the claimed EORECP ii) "being electrically conductive" and "providing a room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm"

As noted above, Wooden's piezoelectric polymers are PVDF, PVF, and cellulose acetate buterate (col. 3, lines 15-18). These are all known to be dielectric materials which have an electrical conductivity at room temperature of substantially less than 10^{-6} S/cm, with PVDF as noted above being about 10^{-14} to 10^{-15} S/cm. Although the epoxy cement used to cement the piezoelectric includes electrically conductive silver particles which render the polymer composite to be electrically conductive, as noted above the silver particles are not part of the

polymer and thus clearly do not change the very low electrical conductivity of the polymer itself. Accordingly, Wooden does not disclose or suggest Applicants; claimed EORECP ii) "providing a room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm".

iii) Applicants' claimed EORECP being "electrochemically oxidizable and reducible"

Applicants have thoroughly searched Wooden and cannot find any disclosure regarding the electrochemical processes of oxidation or reduction (or anything related), nor any materials which provide this attribute. Piezoelectric materials do not redox, instead, as noted above and taught by Wooden, when electrically stimulated, they simply vibrate. Accordingly, Wooden does not disclose or suggest Applicants; claimed EORECP being "electrochemically oxidizable and reducible".

In light of the several important and non-obvious distinctions noted above between Applicants' claimed invention recited in amended claim 1 and Wooden, Applicants submit that amended claim 1 and its respective dependent claims are patentable claims. Although many of Applicants' dependent claims are believed to recite independently patentable limitations, in light of the clear patentability of amended claim 1, Applicants see no need to traverse the Examiner's rejections for the dependent claims.

Amended claim 16 recites a non-toxic biofouling preventative system, comprising:

a polymer-based coating disposed on a solid surface, said coating comprising a polymeric layer, said polymeric layer including at least one electrochemically oxidizable and reducible and electrically conductive polymer (EORECP), said EORECP having at least a partially conjugated polymer backbone and providing a room temperature electrical conductivity of between 0.1 S/cm and 1,000 S/cm,

an electrochemically active counter electrode spaced apart from said coating;

an aqueous solution including an electrolyte in contact with said coating and said counter electrode, and

a power supply for supplying a dynamic electrical signal to said polymeric layer, relative said counter electrode sufficient for oxidization or reduction of said EORECP.

Amended claim 16 includes the EORECP and associated limitations that are recited in amended claim 1. Accordingly, on that basis alone amended claim 16 and its respective dependent claims are patentable claims. Moreover, amended claim 16 now recites "an electrochemically active counter electrode spaced apart from said coating". Wooden's piezoelectric based system is not an electrochemically based system and thus does not utilize a counter electrode, nor an electrolyte. Accordingly, Wooden does not disclose or suggest Applicant's claimed electrochemically active counter electrode. As with amended claim 1, although many of Applicants' dependent claims are believed to recite independently patentable limitations, in light of the clear patentability of amended claim 16, Applicants see no need to traverse the Examiner's rejections for the dependent claims.

Applicants have made every effort to present claims which distinguish over the cited art, and it is believed that all claims are clearly in condition for allowance. However, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic interview (direct line (561) 671-3662) would expedite the prosecution of the application to an allowance.

Although no fee is believed to be due, the Commissioner for Patents is hereby authorized to charge any deficiency in fees due or credit an excess in fees with the filing of the papers submitted herein during prosecution of this application to Deposit Account No. 50-0951.

Respectfully submitted,

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